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SUMMARY

Eroded enamel is more susceptible to abrasive wear than sound enamel. New toothpastes utilizing diamond particles as abrasives have been developed. The present study investigated the abrasive wear of eroded enamel by three commercially available toothpastes (one containing diamond particles) and compared it to the respective wear of sound enamel caused by these toothpastes. Seventy-two bovine enamel samples were randomly allocated to six groups (S1–S3 and E1–E3; n=12). Samples were submitted to an abrasive (S1–S3) or erosion plus abrasion (E1–E3) cycling. Per cycle, all samples were brushed (abrasion; 20 brushing stokes) with the following toothpastes: S1/E1: Signal WHITE SYSTEM, S2/E2: elmex KARIESSCHUTZ and S3/E3: Candida WHITE DIAMOND (diamond particles). Groups E1–E3 were additionally eroded with HCl (pH 3.0) for 2 min before each brushing procedure. After 30, 60 and 90 cycles enamel wear was measured by surface profilometry. Within the same toothpaste and same number of cycles, enamel wear due to erosion plus abrasion was significantly higher than due to mere abrasion. After 30, 60 and 90 cycles, no significant difference in the wear in groups S1 and S2 was observed while the wear in group E1 was significantly ($p<0.05$, ANOVA, Scheffecyc) lower than that in group E2. After 90 cycles, wear in group S3 was about 5 times higher than that in group S2, while wear in group E3 was about 1.3 times higher than that in group E2. As compared to the other two investigated toothpastes, the dentifrice containing diamond particles caused slightly higher abrasive wear of eroded enamel and distinctly higher wear of sound enamel compared to the conventional toothpastes under investigation.

Introduction

Over the last decades, a considerable increase in both prevalence and incidence of dental erosion has been observed (Jaeggi & Lussi 2014). Dental erosion is defined as a chemically induced dental hard tissue loss due to contact with acids. It occurs when the surrounding aqueous phase is undersaturated with respect to tooth minerals in the absence of microorganisms (Larsen 1990). In general, depending on their origin, the acids causing erosive dental hard tissue loss can be divided into extrinsic and intrinsic acids. Source for extrinsic acids are mainly acidic foodstuff and beverages (Barbour & Lussi 2014), medicaments (Hellwig & Lussi 2014), and, more historically, acidic fumes in battery or galvanic factories (Wiegand & Attin 2007). The only intrinsic source for an acid is gastric juice, mainly composed of hydrochloric acid that may come into contact with dental hard tissues during reflux (Bartlett et al. 1996) or vomiting (Roberts & Tylenda 1989).

Initially, erosions are characterized by a softening (hardness loss) of the enamel surface (Lussi et al. 2011) followed by a continuous layer-by-layer dissolution leading to a permanent loss of tooth volume with a softened layer at the surface of the remaining tissue (Lussi et al. 2011). This softened enamel showed an increased susceptibility to abrasion caused by mechanical forces such as tooth brushing (Attin et al. 1998, Wiegand et al. 2007), ultrasonication (Wiegand et al. 2007) or even friction from the tongue (Vieira et al. 2006). For both human and bovine enamel (Attin et al. 2007) and dentine (Wegehaupt et al. 2008), erosion followed by tooth brushing results in an increased wear compared to tooth brushing of the respective sound dental hard tissues.

The abrasivity of toothpastes is mainly determined by their composition with respect to the kind, size, shape and amount of abrasive particles incorporated (Lippert 2013). The abrasivity of toothpastes is expressed as relative enamel or dentine abrasivity (REA or RDA) (Grabenstetter et al. 1958, Hefferren 1976). To determine these values, sound radioactive doped enamel or dentine are brushed with the toothpaste to be tested and the resulting abrasive wear is compared with that caused by a standard abrasive (Gonzalez-Cabezas et al. 2013). Recently, new toothpastes utilizing diamond particles as abrasives have been developed and marketed.

However, to our best knowledge, there is no study evaluating the influence of this kind of toothpaste (abrasives) on the resulting abrasive wear of previous eroded enamel and comparing it to the wear of sound enamel caused by these same toothpastes. It might be hypothesized that a toothpaste causing an x-fold higher abrasive wear of sound enamel compared to a second toothpaste might also cause a proportionally higher abrasive wear of previously eroded enamel compared to the second toothpaste.

Therefore, it was the aim of the present study to investigate the abrasive wear of previously eroded enamel by commercially available toothpastes (one utilizing diamond particles as abrasives) and compare it to the abrasive wear of sound enamel caused by these same toothpastes. The two hypotheses of the present study were (1) that toothpastes causing a similar wear of sound enamel would also cause a similar wear of eroded enamel and (2) that a toothpaste utilizing diamond particles as abrasives will under both circumstances (abrasion only or erosion plus abrasion) cause proportional wear.

Materials and Methods

Sample preparation and allocation

For the study, 72 enamel samples were prepared from freshly extracted bovine lower incisors. The crowns and roots were sectioned at the cementum-enamel junction using a water-cooled diamond disc.

Enamel cylinders (3 mm in diameter) were drilled out from the labial surface of the crowns and were marked with consecutive numbers to keep record of the tooth they were gained from. After placing the enamel cylinders in a custom made mold (6 mm in diameter) they were embedded in acrylic resin (Paladur, Heraeus Kulzer, Hanau, Germany). The cylinders were placed in the moulds with the original enamel surface facing towards the bottom of the mold. After polymerization of the embedding material, the samples were removed from the molds and were ground flat and polished with water-cooled carborundum discs (1200, 2400, 4000 grit) (Water Proof Silicon Carbide Paper, Struers, Erkrath, Germany).

Finally, the samples were randomly allocated to six groups (S1–S3 and E1–E3; n=12). During the allocation process, it was ensured that each group did not contain more than one sample from a single tooth.

Abrasion and erosion plus abrasion procedure

During each abrasion (groups S1–S3) or erosion plus abrasion (E1–E3) cycle, the samples of all groups were brushed in an automatical brushing machine applying reciprocating movements at a frequency of 60 brushing strokes (BS) per minute for 20 s, resulting in an application of 20 BS per cycle. For each sample a specific medium bristle stiffness toothbrush was used (ParoM43, Esro AG, Thalwil, Zürich, Switzerland). A constant brushing force of 2.0 N was adjusted by fixing a respective weight on the toothbrush. During brushing, each sample was covered with 20 ml of toothpaste slurry. The toothpaste slurries were prepared by mixing toothpaste and artificial saliva (Klimek et al. 1982) at a ratio of 1:3. For groups S1 and E1 the slurry was prepared from toothpaste Signal WHITE SYSTEM (Unilever Schweiz, Thayngen, Switzerland). For groups S2 and E2 the toothpaste elmex KARIESSCHUTZ (GABA, Therwil, Switzerland) was used, while for groups S3 and E3 the slurry was prepared from Candida WHITE DIAMOND (Migros, Zurich, Switzerland). For each cycle, a fresh slurry was prepared. After each brushing, the samples were rinsed with tap water for at least 20 s to remove remnants of the respective slurries.

While the samples of groups S1–S3 were "only" brushed (abrasion), the samples of groups E1–E3 were additionally eroded before each brushing cycle (erosion plus abrasion). Each sample of groups E1–E3 was eroded by immersing in 2 ml HCl (pH 3.0) for 2 min. After the erosion and before the brushing, the samples were rinsed with tap water for 20 s to stop the erosive process.

Composition, fluoride contend, fluoride compound and RDA of the used toothpastes are presented in Table I.

Measurement of tooth wear due to abrasion and erosion plus abrasion

From each sample five baseline profiles were recorded by using a stylus profilometer (Perthometer Concept, Mahr, Göttingen, Germany) with a distance of 250 µm between each profile. Before starting the respective abrasion or erosion plus abrasion procedure, part of the enamel and the embedding resin was covered with adhesive tape to protect these areas later to be

Tab. I Composition, fluoride compound, fluoride concentration and RDA of the used toothpastes

Toothpaste	Composition[1]	Fluoride compound[1]	total F (ppm)	RDA
Signal WHITE SYSTEM (Unilever Schweiz, Switzerland)	Calcium Carbonate, Aqua, Sorbitol, Hydrated Silica, Sodium Lauryl Sulfate, Aroma, Sodium Monofluoro-phosphate, Trisodium Phosphate, Perlite, Cellulose Gum, Benzyl Alcohol, Sodium Saccharin, Propylene Glycol, Glycerin, CI 74160, CI77891	Sodium Monofluoro-phosphate[1]	1382[2]	110 ± 14[2]
elmex KARIESSCHUTZ (GABA, Switzerland)	Aqua, Hydrated Silica, Sorbitol, Hydroxyethyl-cellulose, Olafluor, Aroma, Saccharin, Limonene, CI 77891	Olaflur[1]	957[2]	65 ± 3[2]
Candida WHITE DIAMOND (Mibelle AG Cosmetics, Buchs, Switzerland, for Migros, Switzerland)	Aqua, Hydrogenated Starch Hydsolysate, Potassium Citrate, Hydrated Silica, Sodium Lauryl Sulfate, Xan-than Gum, Aroma, Acrylates/C10-30 Alkyl Acrylate Crosspolymer, Sodium Fluoride, Sodium Saccharin, Zinc Chloride, Diamond Powder, Methylparaben, Sodium Hydroxide, Allantoin, Limonene, Linalool, CI 77891	Sodium fluoride[1]	1346[3]	30[1]

[1] Manufactures' information
[2] Information from the study by Tawakoli et al. (Tawakoli et al. 2015)
[3] Values obtained following the measuring method described by Tawakoli et al. (Tawakoli et al. 2015).

used as internal references. After 30, 60 and 90 cycles of abrasion (S1–S3) or erosion plus abrasion (E1–E3), new profiles were recorded. To ensure an exact repositioning of the samples, both profilometer and samples were equipped with a jig. The enamel wear after 30, 60 and 90 cycles of abrasion or erosion plus abrasion was calculated with a custom made software allowing an automatized superimposition of the baseline profiles with the respective profiles after 30, 60 and 90 cycles. If the calculated wear per profile was below the measurement limit of the profilometer of 0.105 µm (Attin et al. 2009), the value for this profile was set as 0.000 µm.

Per sample, the tooth wear was calculated by averaging the values of the five respective profiles. Per group, the respective values were calculated by averaging the values of the twelve samples of the respective group.

Statistical analysis

The enamel wear data were encoded into a Microsoft Excel file. The statistical analysis was then performed using the software program IBM® SPSS® Statistics Version 22 (International Business Machines Corp., Armonk, New York, United States).

Mean, standard deviation, median, interquartile range and 95% confidence interval were calculated.

Data were normally distributed according to the Kolmogorov-Smirnov test. Therefore, data were analyzed by ANOVA and Scheffe's post-hoc method ($p \leq 0.05$).

Results

The enamel wear after 30, 60 an 90 cycles of abrasion or erosion plus abrasion for the different toothpastes is presented in Fig. 1.

Within the same toothpaste and same number of cycles, the enamel wear due to erosion plus abrasion (E1, E2 and E3) was statistically significantly higher than the enamel wear due to abrasion (S1, S2 and S3) ($p=0.000$, respectively).

After 30, 60 and 90 cycles of abrasion, no significant difference in the wear of groups S1 (Signal WHITE SYSTEM) and S2 (elmex KARIESSCHUTZ) was observed. However, the wear of group S3 (Candida WHITE DIAMOND) was statistically significantly higher at all time points of measurement.

For erosion plus abrasion, the enamel wear of group E1 was statistically lower compared to that of groups E2 and E3 at all time points of measurement (30, 60 and 90 cycles) ($p=0.000$, respectively). The statistically highest wear due to erosion plus abrasion was observed in group E3. However, after 30 cycles, no significant difference in the wear of group E2 and E3 was observed ($p=0.071$).

For abrasion and erosion plus abrasion, an increase in the wear with increasing number of cycles was observed for all toothpastes. However, for group S1 from 30 to 60 cycles this increase was not statistically significant.

Discussion

For the present study, samples were prepared from bovine teeth. Bovine enamel samples have been used in numerous studies investigating abrasive and erosive/abrasive wear (Attin et al. 1999, Lagerweij et al. 2006, Rios et al. 2006, Vieira et al. 2006, Moretto et al. 2010). Due to differences in genetics, environment and diet, bovine and human enamel are not identical (Laurance-Young et al. 2011). However, due to a number of reasons – ease to obtain in large quantities (Oesterle et al. 1998), better condition and more uniform composition (Yassen et al. 2011), larger size allowing preparation of more than one sample from a single tooth (Laurance-Young et al. 2011) etc. – bovine enamel has been used in the present study. A study by Attin et al. (Attin et al. 2007) showed that there is no difference in the abrasive wear of human and bovine enamel, however erosion-abrasion caused higher enamel loss in bovine teeth than in human wisdom teeth. Therefore, one might assume that the here found wear due to erosion plus abrasion is overestimated. As the data are only compared with data of the present study (relative data), we assumed that the use of bovine enamel is, due to the above mentioned reasons, acceptable.

Samples of groups E1–E3 were eroded for 2 min before the abrasion. This duration has been recommended by Wiegand and

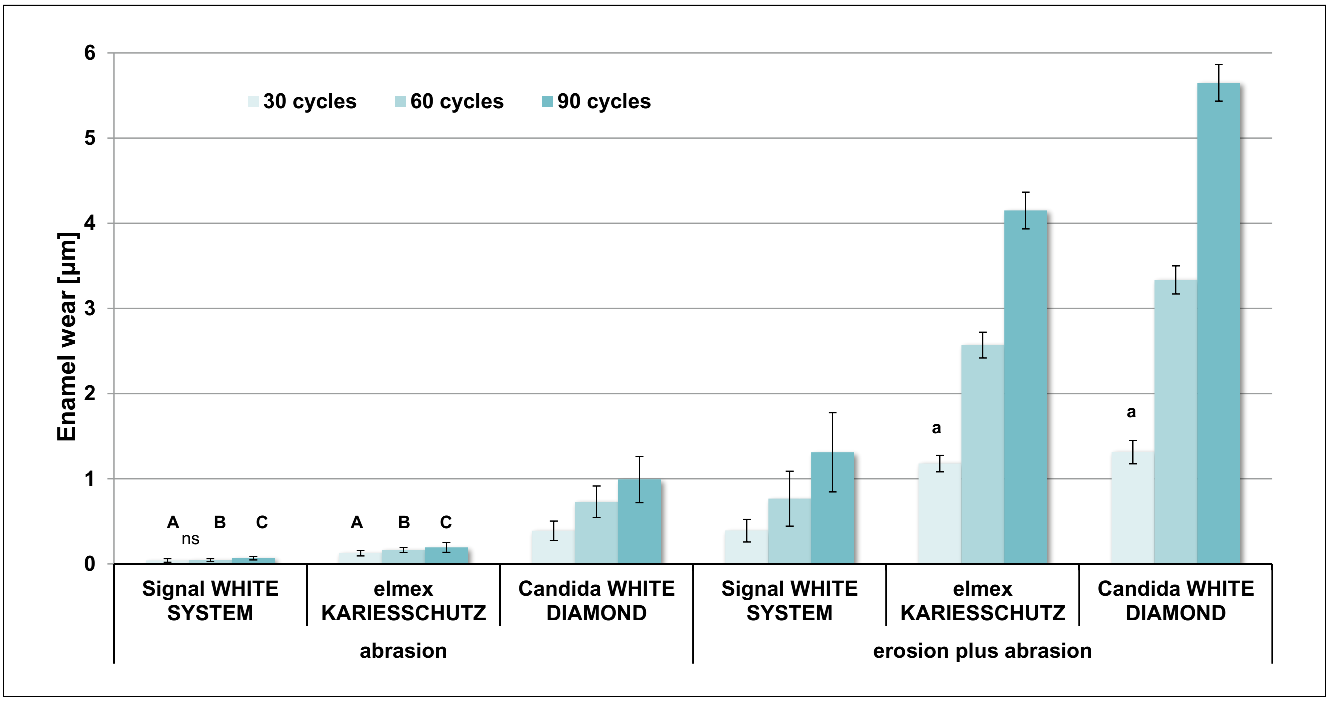

Fig. 1 Mean (SD) wear [µm] for the different toothpastes after 30, 60 and 90 cycles of abrasion and erosion plus abrasion.
Values within the same kind of challenge (abrasion or erosion plus abrasion) and the same number of cycles for the different toothpastes that are not significantly different are marked with same letters (capital and lowercase letters for abrasion and erosion plus abrasion, respectively).
Values within the same kind of challenge (abrasion or erosion plus abrasion) and the same toothpaste that are not significantly different are marked with "ns".

Attin (Wiegand & Attin 2011) and seems to represent the duration of a rapid consumption of an acidic beverage (Meurman et al. 1987). Also the number of brushing strokes used in the present study per cycle was chosen based on the recommendations by Wiegand and Attin (Wiegand & Attin 2011).

A limitation of the present study might be that no remineralization period between erosion and abrasion was simulated. This remineralization period might increase the stability of the previously eroded enamel and therefore reduce the resulting wear due to abrasion. A previous study (Ganss et al. 2007) has shown that a remineralization period between erosion and tooth brushing has only a minor effect on the resulting erosion/abrasion tooth wear. Furthermore, Attin et al. showed that even after a period of 1 h of remineralization, abrasion of previously eroded enamel is increased (Attin et al. 2000) The absence of a remineralization period simulates a worst-case scenario, as it occurs when patients brush their teeth directly after vomiting or the consumption of an acidic beverage. Moreover, the focus of the study was to examine pure abrasiveness of the toothpastes, thus remineralization phases were intentionally not included.

The first hypothesis of the present study that toothpastes causing a similar wear of sound enamel would also cause a similar wear of eroded enamel has to be rejected. After 30, 60 and 90 cycles no significant difference in the abrasive wear caused by Signal WHITE SYSTEM and elmex KARIESSCHUTZ was observed, while the wear due to erosion plus abrasion caused by elmex KARIESSCHUTZ was significantly higher at all time points of measurement. Additionally, the abrasive wear caused by Candida WHITE DIAMOND was about 3–5 times higher than that caused by elmex KARIESSCHUTZ at 30, 60 and 90 cycles, while the wear caused by erosion plus abrasion by Candida WHITE DIAMOND was 1.3 times higher at maximum than that of elmex KARIESSCHUTZ. At 30 cycles, the erosion plus abrasion wear of these two toothpastes was even not statistically significantly different. These results showed that the differences in the wear due to erosion plus abrasion of two toothpastes are not necessarily proportional to the differences in the wear due to mere abrasion by these two toothpastes.

According to the above mentioned findings, also the second hypothesis that a toothpaste utilizing diamond particles as abrasives will under both circumstances (abrasion only or erosion plus abrasion) cause proportional wear has to be rejected. Taking into consideration the findings of the present study, one has to assume that the composition of toothpastes affects the abrasion of sound and eroded enamel differently. Concerning Candida WHITE DIAMOND it might be hypothesized that the diamond particles are responsible for the findings observed for the wear due to abrasion and erosion plus abrasion. Diamond particles, which are very hard, abrade hard sound enamel more easily, while the more soft eroded enamel is apparently less affected. This might be due to the fact, that the particles might rather slip through the erosively softened enamel surfaces than cutting and abrading the enamel.

A present study by Tawakoli et al. (Tawakoli et al. 2015) reported an RDA value of 65 ± 3 for elmex KARIESSCHUTZ and of 110 ± 14 for Signal WHITE SYSTEM. With regard to this finding, one could assume that Signal WHITE SYSTEM would cause a higher wear due to abrasion and erosion plus abrasion than elmex KARIESSCHUTZ in the present study. However, in the present study the wear due to abrasion of the two toothpastes was not significantly different. Additionally, the wear due to abrasion caused by Candida WHITE DIAMOND was significantly higher than that caused by elmex KARIESSCHUTZ and Signal WHITE SYSTEM although the RDA of Candida WHITE DIAMOND is considerably lower than that of elmex KARIESSCHUTZ and Signal WHITE SYSTEM. Thus it can be assumed that the RDA is not necessarily a good predictor for the abrasion of enamel (Joiner et al. 2004). As the wear due to erosion plus abrasion of Signal WHITE SYSTEM was significantly lower than the respective wear caused by elmex KARIESSCHUTZ one might further assume that other factors beside abrasiveness might influence the wear of erosively softened enamel. One of these factors might be the fluoride content of the toothpastes. Tawakoli et al. reported a total fluoride content of 979 ppm for elmex KARIESSCHUTZ and of 1382 ppm for Signal WHITE SYSTEM (Tawakoli et al. 2015). The assumption that the fluoride content influences the abrasion of eroded enamel in a cycling model is supported by a study by Attin et al. (Attin et al. 1999). They observed that brushing eroded enamel with a fluoridated gel results in a low wear than brushing with a non-fluoridated gel. In this study it was hypothesized that the fluoride deposited on the surface of the enamel during brushing reduces the erosive effect of the afterwards applied acidic substances. Beside the differences in the fluoride content also the differences in the used kind of fluoride compound might have an influence on the resulting abrasive and erosive/abrasive wear.

In 2013, Gonzalez-Cabezas et al. (Gonzalez-Cabezas et al. 2013) stated that despite the evidence of the higher susceptibility of surface-softened enamel to abrasiveness of dentifrices, there is no standard method to evaluate it (Gonzalez-Cabezas et al. 2013). Taking into consideration the before mentioned and the findings of the present study, one might think about developing a measuring method for the abrasiveness of toothpastes on eroded enamel and introducing a respective value (e.g. relative eroded enamel abrasiveness = REEA). Such a value might help dentist recommending toothpastes, that cause low or less abrasive wear of eroded enamel, to their respective patients to minimize the abrasion of the eroded enamel in patients suffering from erosion.

Conclusion

Within the limitations of the present study it can be concluded that the abrasiveness of a toothpaste relative to that of another toothpaste depends on the condition (sound or previously eroded) of the enamel that is treated. Furthermore, the dentifrice containing diamond particles caused slightly higher abrasive wear of eroded enamel and distinctly higher wear of sound enamel as compared to the other two investigated toothpastes.

Résumé

Introduction

On sait que l'émail érodé est plus sensible que l'émail sain aux influences mécaniques (en particulier pendant le brossage des dents). Dernièrement, un dentifrice contenant des particules de diamant comme substances abrasives a été développé et mis sur le marché suisse. Afin d'informer adéquatement les patients au sujet d'un potentiel abrasif possible de ce dentifrice, l'objet de l'étude présente était de déterminer le potentiel abrasif de l'émail érodé par trois dentifrices disponibles dans le commerce (dont l'un avec des particules de diamant) et de comparer l'usure abrasive avec celui de l'émail sain.

Matériel et méthodes: 72 échantillons d'émail bovins ont été préparés et divisés en six groupes (S1–S3 et E1–E3 1–8; n=12). Ensuite, un cycle abrasif (S1–S3) ou un cycle érosif/abrasif a été effectué. Les échantillons ont été brossés avec les dentifrices suivants pour le cycle (chaque abrasion, 20 coups de brosse): S1/E1: Signal WHITE SYSTEM , S2/E2: elmex KARIESSCHUTZ und S3/E3: Candida WHITE DIAMOND (particules de diamant). Les échantillons du groupe E1–E3 ont été en plus érodés dans chaque cycle (avant abrasion), pendant deux minutes, avec de l'acide chlorhydrique (pH 3,0).

Au bout de 30, 60 et 90 cycles d'abrasion (S1–S3) ou d'érosion/abrasion (E1–E3), la perte de la structure dentaire résultante a été déterminée à l'aide d'un profilomètre de contact.

Résultats

Dans le même nombre de cycles (30, 60 ou 90) et avec le même dentifrice, la perte de l'émail par érosion/abrasion a été (E1–E3) nettement supérieure à la perte correspondante de l'émail par abrasion (S1–S3). Au bout de 30, 60 et 90 cycles, aucune différence significative dans la perte d'émail par abrasion des échantillons S1 et S2 n'a été observée, tandis que la perte d'émail érosive/abrasive des échantillons E1 était significativement inférieure à celui du groupe E2. Après 90 cycles d'abrasion, la perte de l'émail du groupe S3 a été environ cinq fois supérieure à la perte de l'émail du groupe S2. En revanche, la perte d'émail érosive/abrasive du groupe E3 était environ seulement 1,3 fois supérieure à celle du groupe E2.

Discussion

Dans les limites de l'étude présente, on peut conclure que l'abrasivité relative d'un dentifrice par rapport aux autres dépend de la nature de l'émail (sain ou érodé). Par rapport aux deux autres dentifrices étudiés, le dentifrice contenant des particules de diamant a provoqué une abrasion peu élevée sur de l'émail déjà érodé, mais plus conséquente sur de l'émail sain.

Zusammenfassung

Einleitung

Es ist bekannt, dass erodierter Schmelz empfindlicher als gesunder Schmelz gegenüber mechanischen Einflüssen (insbesondere Zähneputzen) ist. In letzter Zeit ist eine Zahnpaste entwickelt und auf den Schweizer Markt gebracht worden, die Diamantpartikel als Abrasivstoffe enthält. Um Patienten adäquat über das mögliche abrasive Potenzial einer solchen Zahnpaste zu informieren, war es das Ziel der vorliegenden Studie, den abrasiven Zahnhartsubstanzverlust von erodiertem Schmelz durch drei kommerziell erhältliche Zahnpasten (eine mit Diamantpartikeln) zu bestimmen und mit dem abrasiven Zahnhartsubstanzverlust von gesundem Schmelz zu vergleichen.

Material und Methoden: Es wurden 72 bovine Schmelzproben hergestellt und auf 6 Gruppen (S1–S3 und E1–E3 1–8; n=12) aufgeteilt. Die Proben wurden anschliessend einem abrasiven (S1–S3) oder erosiv/abrasiven Zyklus zugeführt. Pro Zyklus wurden die Schmelzproben mit den folgenden Zahnpasten gebürstet (Abrasion, je 20 Bürststriche): S1/E1: Signal WHITE SYSTEM, S2/E2: elmex KARIESSCHUTZ und S3/E3: Candida WHITE DIAMOND (Diamantpartikel). Die Proben der Gruppen E1–E3 wurden in jedem Zyklus zusätzlich noch (vor der Abrasion) für 2 min mit Salzsäure (pH 3,0) erodiert.

Nach 30, 60 und 90 Zyklen Abrasion (S1–S3) oder Erosion/Abrasion (E1–E3) wurde der resultierende Zahnhartsubstanzverlust mit einem Kontaktprofilometer bestimmt.

Resultate

Innerhalb der selben Anzahl an Zyklen (30, 60 oder 90) und derselben Zahnpaste war der Schmelzverlust durch Erosion/Abrasion (E1–E3) immer signifikant höher als der entsprechende Schmelzverlust nur durch Abrasion (S1–S3). Nach 30, 60 und

90 Zyklen konnte kein signifikanter Unterschied im rein abrasiven Schmelzverlust der Proben S1 und S2 beobachtet werden, wohingegen der erosiv/abrasive Schmelzverlust der Gruppe E1 signifikant geringer war als der der Gruppe E2. Nach 90 Zyklen reiner Abrasion war der resultierende Schmelzverlust der Gruppe S3 ca. 5 mal höher als der Schmelzverlust der Gruppe S2. Im Gegensatz hierzu war der erosiv/abrasive Schmelzverlust der Gruppe E3 nur ca. 1,3 mal höher als der Schmelzverlust der Gruppe E2.

Diskussion

Innerhalb der Limitationen der vorliegenden Studie kann geschlussfolgert werden, dass die relative Abrasivität einer Zahnpaste im Vergleich zu einer anderen von der Beschaffenheit des Schmelzes (gesund oder erodiert) abhängig ist. Im Vergleich zu den beiden anderen untersuchten Zahnpasten zeigte die Zahnpaste mit Diamantpartikeln eine geringfügig erhöhte Abrasion von zuvor erodiertem Schmelz wohingegen die Abrasion von gesundem Schmelz deutlich erhöht war.

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